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(54) ## Color image pickup device.

(57) A color image pickup device comprises an image pickup tube 11, a color stripe filter 11a comprising a plurality of stripe groups each having a plurality of stripes, a filter circuit 40 for extracting a fundamental wave component and a second harmonic wave component from an output of the color stripe filter, and a circuit 13, 14a, 14b, 15, 16 for obtaining a color multiplexed signal by multiplexing color components obtained via the color stripe filter and the filter circuit in a direction perpendicular to the scanning direction for every one stripe group. The color stripe filter is arranged on the image pickup tube so that a longitu-

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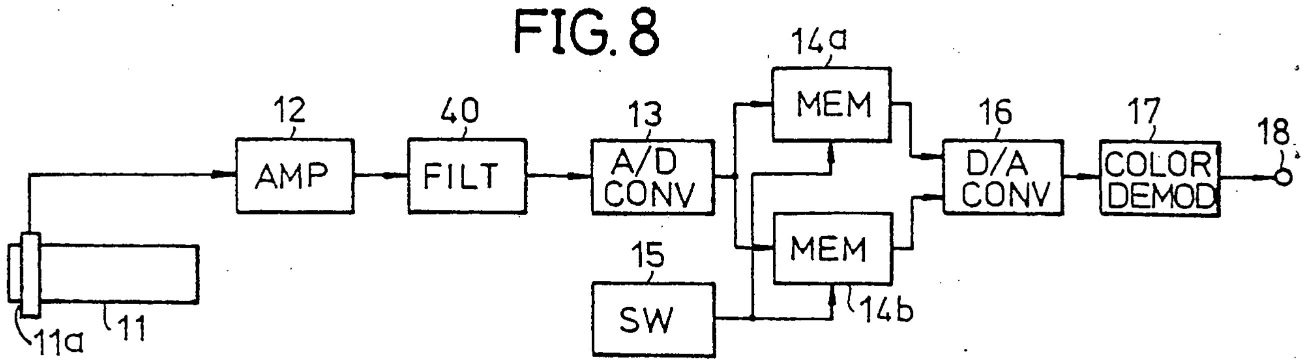
dinal direction of the stripes of the color stripe filter is substantially parallel to a scanning direction of the image pickup tube. A color demodulated signal is produced from the color multiplexed signal.

FIG. 8



COLOR IMAGE PICKUP DEVICE

The present invention generally relates to color image pickup devices, and more particularly to a color image pickup device which obtains a color multiplexed signal from a pickup tube provided with a color stripe filter and performs a color demodulation in a single tube color television camera, for example.

In a conventional single tube color television camera, a color multiplexed signal is obtained by performing a scan in a direction perpendicular to the longitudinal direction of stripes of a color stripe filter which comprises a repetition of green (G), cyan (C) and white (W or transparent) stripes.

However, because the scanning is performed in the direction perpendicular to the longitudinal direction of the stripes of the color stripe filter, color components obtained via the color stripe filter are multiplexed by a carrier of 4 MHz which is relatively high for one period of the color stripe filter (that is, for one group of the G, C and W stripes). Generally, noise is high in the high frequency range, and the degree of modulation of the image pickup tube is low in the high frequency range. As a result, the signal-to-noise ratio becomes poor. In addition, the image pickup tube cannot reproduce color stripes with a high fidelity, and there is a problem in that the color reproducibility is poor.

Furthermore, since the scanning is performed in the direction perpendicular to the longitudinal direction of the stripes of the color stripe filter, the color components obtained via the color stripe filter are multiplexed in the scanning direction. For this reason, the frequency band of the luminance signal becomes limited to a narrow frequency band by the color multiplexed signal (carrier), and there is a problem in that it is impossible to obtain a satisfactory horizontal resolution.

Accordingly, in order to eliminate the above described problems, a color image pickup device was previously proposed in a European Patent Application No.86304474.9 filed June 11, 1986 in which the applicant is the same as the applicant of the present application. The proposed color image pickup device comprises an image pickup tube and a color stripe filter comprising a plurality of stripe groups each having a plurality of stripes. The color stripe filter is arranged on the image pickup tube so that a longitudinal direction of the stripes of the color stripe filter is substantially parallel to a scanning direction of the image pickup tube. Further, there is provided color multiplexed signal obtaining means for obtaining a color multiplexed signal by multiplexing color components obtained via the color stripe filter in a direction perpendicular to the scanning direction for every one stripe group.

According to the proposed color image pickup device, the scanning is performed in the longitudinal direction of the stripes of the color stripe filter. For this reason, the color components are multiplexed by a carrier having a frequency of 94.5 kHz (= fundamental wave component frequency of 15.75 kHz × 6) which is relatively low for one period (corresponding to one horizontal scanning period of the NTSC system) of the stripe group comprising the G, C and W stripes. As a result, the signal-to-noise ratio is high. In addition, the image pickup tube can reproduce the color stripes with a high fidelity, and the color reproducibility is generally satisfactory.

Furthermore, since the scanning is performed in the longitudinal direction of the stripes of the color stripe filter, the color components obtained via the color stripe filter are not multiplexed in the horizontal direction (scanning direction). For this reason, it is possible to obtain the same resolution as in the case of a black-and-white picture, and the frequency band of the luminance signal will not be limited by the color multiplexed signal (carrier). The frequency band of the luminance signal can be made wide, and it is possible to obtain a satisfactory horizontal resolution.

However, when the color demodulation is carried out in the proposed color image pickup device, a fundamental wave component and a second harmonic wave component are generated with respect to the luminance signal. The fundamental wave component and the second harmonic wave component together with the luminance signal cause a pseudo color signal to be generated as will be described later in conjunction with the drawings, and there is a problem in that the reproduced color may not be correct because of the pseudo color signal.

Accordingly, it is a general object of the present invention to provide a novel and useful color image pickup device in which the problems described heretofore are eliminated.

Another and more specific object of the present invention is to provide a color image pickup device in which a color stripe filter is arranged on an image pickup tube so that a longitudinal direction of the stripes of the color stripe filter is substantially parallel to a scanning direction of the image pickup tube, and a fundamental wave component and a second harmonic wave component are extracted from an output of the color stripe

filter in a filter circuit before a color multiplexed signal is obtained by multiplexing color components obtained via the color stripe filter and the filter circuit in a direction perpendicular to the scanning direction. According to the color image pickup device of the present invention, it is possible to reproduce correct colors by use of a simple circuit.

Other objects and further features of the present invention will be apparent from the following detailed description when read in conjunction with the accompanying drawings.

FIG.l is a system block diagram showing a previously proposed color image pickup device;

FIG.2 is a diagram showing a portion of a color stripe filter used in the color image pickup device shown in FIG.l and sampling points;

FIGS.3A and 3B are diagrams for explaining a write-in operation to a memory in the color image pickup device shown in FIG.l;

FIGS.4A and 4B respectively show an input signal waveform to a color demodulating circuit in the color image pickup device shown in FIG.l and a luminance signal waveform;

FIG.5 is a system circuit diagram showing the construction of a switching circuit within the color image pickup device shown in FIG.l;

FIGS.6(A) through 6(D) show signal waveforms for explaining the operation of the circuit system shown in FIG.5;

FIG.7 shows a frequency versus level characteristic for explaining a pseudo color signal generated in the color image pickup device shown in FIG.l;

FIG.8 is a system block diagram showing an embodiment of the color image pickup device according to the present invention;

FIGS.9A and 9B respectively show a fundamental wave component and a second harmonic wave component and a color stripe filter of the color image pickup device according to the present invention in correspondence with each other;

FIG.l0 shows an embodiment of a filter circuit in the color image pickup device shown in FIG.8;

FIGS.ll, l2A and l2B respectively show frequency versus level characteristics for explaining a pseudo color signal generated in the color image pickup device according to the present invention; and

FIG.l3 shows another embodiment of the filter circuit in the color image pickup device shown in FIG.8.

In order to facilitate the understanding of the present invention, description will first be given on the color image pickup device previously proposed in the European Patent Application No.86304474.9 referred to before.

FIG.l shows the previously proposed color image pickup device, and FIG.2 shows a portion of a color stripe filter used in this device for explaining the relationship between scanning lines and sampling positions.

As shown in FIG.2, a color stripe filter lla comprises a repetition of green (G), cyan (C) and white (W or transparent) stripes. The color image pickup device performs the scanning in a longitudinal direction of the stripes of the color stripe filter lla. A number of scanning lines L is set to such a number that the color stripe filter lla can reproduce the samples. For example, the number of scanning lines L for stripe group consisting of the G, C and W stripes is set to six. According to the energy step system, a fundamental wave component and a second harmonic component are to be reproduced. Thus, it may be understood from the sampling theorem that it is possible to reproduce the fundamental wave component and the second harmonic component when there are four or more scanning lines L per one stripe group.

In FIG.l, a signal obtained from an image pickup tube ll which is provided with the color stripe filter lla shown in FIG.2 is passed through a preamplifier l2 and is supplied to an analog-to-digital (A/D) converter l3 wherein the signal is converted into a digital signal. The output digital signal of the A/D converter l3 is supplied to field memories l4a and l4b. A control signal is supplied to the memories l4a and l4b from a switching circuit l5 so as to control write-in and read-out operations of the memories l4a and l4b.

One period of the stripe groups of the color stripe filter lla is set to correspond to one horizontal scanning period of the television system such as the NTSC, PAL and SECAM systems. In a first horizontal scanning period, a signal from the A/D converter l3 related to a first stripe group Pl is written into the memory l4a as shown in FIG.3A in a sequence of sampled data at sampling points all, al2, al3, ..., a2l, a22, a23, ..., a3l, a32, a33, ... shown in FIG.2. In other words, the sampled data related to the first stripe group Pl are successively written into the memory l4a in the sequence of the sampled data arranged in the horizontal direction. In a second horizontal scanning period, the stored sampled data related to the first stripe group Pl are successively read out from the memory l4a in a sequence of the sampled data at the sampling points all, a2l, a3l, a4l, a5l, a6l, al2, a22, a32, a42, a52, a62, al3, a23, a33, a43, a53, a63, ... In other words, the stored sampled data are read out from the memory l4a in the sequence of the stored sampled data arranged in a direction perpendicular to the write-in direction. On the other hand, in the second horizontal scanning period, a signal from the A/D converter l3 related to a second stripe

group P2 is written into the memory 14b as shown in FIG.3B in a sequence of sampled data at sampling points a71, a72, a73, ..., a81, a82, a83, ..., a91, a92, a93, ... , similarly as in the case of the write-in to the memory 14a in the first horizontal scanning period.

In a third horizontal scanning period, the stored sampled data related to the second stripe group P2 are successively read out from the memory 14b in a sequence of the sampled data at the sampling points a71, a81, a91, ..., a72, a82, a92, ..., a73, a83, a93, ... In other words, the stored sampled data are read out from the memory 14b in the sequence of the stored sampled data arranged in a direction perpendicular to the write-in direction. Furthermore, in this third horizontal scanning period, a signal from the A/D converter 13 related to a third stripe group is newly written into the memory 14a.

Similarly thereafter, the write-in and read-out operations are alternately performed in the memories 14a and 14b for the signal related to each stripe group, and such operations are repeated. As a result, the write-in and read-out operations are performed for each stripe group, that is, for each horizontal scanning period. The signals read out from the memories 14a and 14b for every one horizontal scanning period of the NTSC system are supplied to a digital-to-analog (D/A) converter 16 wherein the signals are converted into an analog signal.

The switching circuit 15 may have a construction shown in FIG.5. In FIG.5, a horizontal synchronizing signal HD is applied to a terminal 30 and is supplied to a 1/2 frequency divider 31 wherein the signal is frequency-divided by 1/2. As a result, signals LNSa and LNSb shown in FIGS.6(A) and 6(B) are obtained from the frequency divider 31. On the other hand, a clock signal CLK is applied to a terminal 32 is supplied to OR gates 33a and 33b which are respectively supplied with the signals LNSa and LNSb. Hence, write-in and read-out control signals $\overline{WEa}$ and $\overline{WEb}$ shown in FIGS.6(C) and 6(D) are obtained from the OR gates 33a and 33b.

A write-in address generated by a write-in address generator 34 and a read-out address generated by a read-out address generator 35 are supplied to a multiplexer 36. This multiplexer 36 is also supplied with the output signals LNSa and LNSb of the frequency divider 31. Hence, the multiplexer 36 alternately produces the write-in address and the read-out address with a period of one horizontal scanning period, in synchronism with the timing of the signal LNSa, for example. The output address of the multiplexer 36 is supplied to the memories 14a and 14b.

Accordingly, during a time period t_W shown in FIG.6(C), for example, the memory 14a performs a write-in operation responsive to the control signal $\overline{WEa}$ to write data at a write-in address. During a next time period t_R shown in FIG.6(C), the memory 14a performs a read-out operation responsive to the control signal $\overline{WEb}$ to read out stored data from a read-out address. The memory 14a alternately performs the write-in operation and the read-out operation for every one horizontal scanning period, and such write-in and read-out operations are repeated. On the other hand, the memory 14b performs the write-in and read-out operations similarly as in the case of the memory 14a, except that the memory 14b performs the read-out operation while the memory 14a performs the write-in operation and performs the write-in operation while the memory 14a performs the read-out operation.

The signals LNSa and LNSb from the frequency divider 31 are also supplied to data latch circuits (not shown) which are respectively provided at input and output stages of the memories 14a and 14b, so as to control the timings of input and output data of the memories 14a and 14b to regular timings.

The output signal of the D/A converter 16 comprises the data of each stripe group arranged on the time base as shown in FIG.4A. This signal shown in FIG.4A is similar to a color multiplexed signal obtained in accordance with the general energy step system. When the sampling theorem is satisfied, the output signal of the D/A converter 16 becomes similar to the color multiplexed signal obtained by multiplexing the color components according to the energy step system, and it is possible to reproduce a fundamental wave component signal and a second harmonic wave component signal with a high fidelity even when the sampling phase and frequency change.

The output signal of the D/A converter 16 is supplied to a color demodulating circuit 17 which has a construction similar to a color demodulating circuit used in the case of the energy step system, and is subjected to a color demodulation. An output signal of the color demodulating circuit 17 is obtained via an output terminal 18.

On the other hand, the output signal of the D/A converter 16 is also supplied to an adder 19 wherein the data of one stripe group are added for each of the stripe groups, and a luminance signal shown in FIG.4B is produced from the adder 19. The output luminance signal of the adder 19 is obtained via an output terminal 20.

According to the proposed color image pickup device, the scanning is performed in the longitudinal direction of the stripes of the color stripe filter 11a. For this reason, the color components are mul-

tiplexed by a carrier having a frequency of 94.5 kHz (= fundamental wave component frequency of 15.75 kHz × 6) which is relatively low for one period (corresponding to one horizontal scanning period of the NTSC system, for example) of the stripe group comprising the G, C and W stripes. As a result, the signal-to-noise ratio is high. In addition, the image pickup tube can reproduce the color stripes with a high fidelity, and the color reproducibility is generally satisfactory.

Furthermore, since the scanning is performed in the longitudinal direction of the stripes of the color stripe filter lla, the color components obtained via the color stripe filter lla are not multiplexed in the horizontal direction (scanning direction). For this reason, it is possible to obtain the same resolution as in the case of a black-and-white picture, and the frequency band of the luminance signal will not be limited by the color multiplexed signal (carrier). The frequency band of the luminance signal can be made wide, and it is possible to obtain a satisfactory horizontal resolution.

In this case, the color stripe filter lla comprises 240 stripe groups (corresponding to one field of the NTSC system). When it is assumed that the vertical resolution for one stripe group is two television scanning lines, the vertical resolution as a whole is 480 television scanning lines, and the vertical resolution is the same as that of the conventional image pickup device.

In the case where the image pickup tube is designed to scan in the vertical direction, the color stripe filter should be arranged so that longitudinal direction of the stripes of the color stripe filter coincides with the vertical direction. In this case, the write-in to the memories l4a and l4b is performed in a sequence of the data arranged in the vertical direction and the read-out from the memories l4a and l4b is performed in a direction perpendicular to the write-in direction, that is, in the horizontal direction.

In addition, the color multiplexed signal is obtained for each of the stripe groups arranged in the direction perpendicular to the scanning direction. For this reason, the sampled data can be written into and read out from the memories for every one horizontal scanning period of the NTSC system, for example, and it is unnecessary to provide special means for dividing the sampled data read out from the memories into a data group for every one horizontal scanning period. Consequently, the memory capacities of the memories do not need to be extremely large.

However, when the color demodulation is carried out in the proposed color image pickup device, a fundamental wave component II and a second harmonic wave component III are generated with respect to a luminance signal I as shown in FIG.7. The fundamental wave component II and the second harmonic wave component III together with the luminance signal I cause a pseudo color signal to be generated in a range indicated by hatchings in FIG.7, and there is a problem in that the reproduced color may not be correct because of the pseudo color signal.

The present invention extracts the fundamental wave component and the second harmonic wave component before obtaining the color multiplexed signal, so that it is possible to reproduce correct colors.

FIG.8 shows an embodiment of the color image pickup device according to the present invention. In FIG.8, those parts which are the same as those corresponding parts in FIG.I are designated by the same reference numerals, and description thereof will be omitted.

In FIG.8, a filter circuit 40 is provided between the preamplifier l2 and the A/D converter l3. As will be described later in conjunction with FIG.l0, the filter circuit 40 comprises bandpass filters 40a and 40b. The image pickup tube ll comprises the color stripe filter lla shown in FIG.9B, and the number of scanning lines La for one stripe group consisting of the G, C and W stripes is set to four in the present embodiment.

The relationships of the filter stripes of the color stripe filter lla with the fundamental wave component and the second harmonic wave component are shown in FIGS.9A and 9B. One period of the fundamental wave component corresponds to one stripe group consisting of the G, C and W stripes as indicated by a solid line (1) in FIG.9A. Two periods of the second harmonic wave component correspond to one stripe group consisting of the G, C and W stripes as indicated by a phantom line (2) in FIG.9A. Thus, as may be seen from FIGS.9A and 9B, an interval between two successive scanning lines corresponds to a 90° phase angle of the fundamental wave component, and this interval between two successive scanning lines corresponds to a l80° phase angle of the second harmonic wave component.

FIG.l0 shows an embodiment of the filter circuit 40. The filter circuit 40 comprises the bandpass filters 40a and 40b and an adder 45. The bandpass filter 40a comprises a two scanning line delay circuit 4l and a subtracting circuit 43. The delay circuit 4l delays the output of the preamplifier l2 obtained via a terminal 39 by two scanning lines, and the subtracting circuit 43 subtracts from a delayed output of the delay circuit 4l the output of the preamplifier l2 (that is, the input of the delay circuit 4l). Hence, as may be readily understood from FIGS.9A and 9B, a fundamental wave component sl is obtained from the subtracting circuit 43 in a frequency band IIf indicated by a solid line about

a frequency fl as shown in FIG.II. On the other hand, the bandpass filter 40b comprises a one scanning line delay circuit 42 and a subtracting circuit 44. The delay circuit 42 delays the output of the preamplifier I2 obtained via the terminal 39 by one scanning line, and the subtracting circuit 44 subtracts from a delayed output of the delay circuit 42 the output of the preamplifier I2 (that is, the input of the delay circuit 42). Hence, as may be readily understood from FIGS.9A and 9B, a second harmonic wave component s2 is obtained from the subtracting circuit 44 in a frequency band IIIh indicated by a solid line about a frequency f2 as shown in FIG.II. In other words, in each of the bandpass filters 40a and 40b, the desired component is obtained by carrying out an operation between signals having a I80° phase difference. The fundamental wave component sl and the second harmonic wave component s2 are added in the adder 45 and an added signal is supplied to the A/D converter I3 shown in FIG.8 via a terminal 46.

By providing the filter circuit 40, it is possible to extract from the output of the preamplifier I2 only the fundamental wave component II in the frequency band IIf and the second harmonic wave component III in the frequency band IIIh shown in FIG.II. The characteristic of the luminance signal is indicated by a phantom line I. As a result, the pseudo color signal is only generated in a range indicated by hatchings in FIG.II, and it can be readily seen that the effects of the pseudo color signal can be reduced considerably in the present embodiment when compared to the case shown in FIG.7 described before. Therefore, it is possible to reproduce correct colors according to the present embodiment.

It is possible to arbitrarily select the frequency bands in which the fundamental wave component and the second harmonic wave component are to be obtained by using feedback type filters for the bandpass filters 40a and 40b. In the case where frequency bands IIfa and IIIha shown in FIG.I2A are selected for the fundamental wave component and the second harmonic wave component, respectively, the pseudo color signal is only generated in a range indicated by hatchings. On the other hand, in the case where frequency bands IIfb and IIIhb shown in FIG.I2B are selected for the fundamental wave component and the second harmonic wave component, respectively, the pseudo color signal is only generated in a range indicated by hatchings. It can be seen from FIGS.I2A and I2B that the effects of the pseudo color signal can further be reduced by use of the feedback type filters compared to the case shown in FIG.II.

FIG.I3 shows an embodiment of the filter circuit 40 using feedback type filters for the bandpass filters 40a and 40b. In FIG.I3, those parts which are the same as those corresponding parts in FIG.I0 are designated by the same reference numerals, and description thereof will be omitted.

In FIG.I3, the filter circuit 40 comprises feedback type filters 40al and 40bl and the adder 45. The feedback type filter 40al comprises a coefficient multiplier 50 for multiplying a coefficient $1-\beta$, an adder 5I, the two scanning line delay circuit 4I, the subtracting circuit 43 and a coefficient multiplier 52 for multiplying a coefficient β. For example, the coefficient β is selected in a range of zero to one. The output of the preamplifier I2 shown in FIG.8 is obtained from the terminal 39 and is supplied to the adder 5I via the coefficient multiplier 50. An output of the adder 5I is supplied to the subtracting circuit 43 via the two scanning line delay circuit 4I, and the subtracting circuit 43 subtracts the input of the two scanning line delay circuit 4I from the output of the two scanning line delay circuit 4I. The output of the subtracting circuit 43 is fed back to the adder 5I via the coefficient multiplier 52. The feedback type filter 40bl has a construction similar to the feedback type filter 40al, and comprises a coefficient multiplier 53, an adder 54, the one scanning line delay circuit 42, the subtracting circuit 44 and a coefficient multiplier 55. The adder 45 adds the outputs of the subtracting circuits 43 and 44, and the output of the adder 45 is supplied to the A/D converter I3 shown in FIG.8 via the terminal 46. By appropriately selecting the coefficients of the coefficient multipliers 50, 52, 53 and 55, it is possible to select the frequency bands in which the fundamental wave component and the second harmonic wave component are to be obtained, such as the frequency bands IIfa and IIIha or IIfb and IIIhb shown in FIGS.I2A and I2B.

The number of scanning lines La for one stripe group consisting of the G, C and W stripes is not limited to four. In a modification of the embodiment of the invention described before, the number of scanning lines La for one stripe group may be set to 3.5, for example. In this case, an interval between two successive scanning lines corresponds to a I02.8° (≒ 360°/3.5) phase angle of the fundamental wave component, and this interval between two successive scanning lines corresponds to a 205.6° (≒720°/3.5) phase angle of the second harmonic wave component. As a result, the fundamental wave component and the second harmonic wave component no longer have the I80° phase relationship, and the respective center frequencies fl and f2 of the fundamental wave component and the second harmonic wave component shift to frequencies fla and f2a shown in FIG.II. However, the shifts are small in that when the level

is assumed to be l.0 at the center frequency fl of the fundamental wave component ll and at the center frequency f2 of the second harmonic wave component lll, the level at the respective shifted center frequencies fla and f2a of the fundamental wave component ll and the second harmonic wave component lll is 0.98 and is extremely close to l.0. Hence, the passbands llf and lllh of the bandpass filters 40a and 40b shown in FIG.l0 only change slightly by such small shifts in the center frequencies, and no inconveniences will be introduced even when the circuit shown in FIG.l0 is used for the case where the numter of scanning lines La for one stripe group is set to 3.5, for example.

In the embodiments described heretofore, the television system is not limited to the NTSC system. Furthermore, the number of stripe groups may be set arbitrarily according to the needs.

In the case where the image pickup tube is designed to scan in the vertical direction, the color stripe filter should be arranged so that the longitudinal direction of the stripes of the color stripe filter coincides with the vertical direction. In this case, the write-in to the memories l4a and l4b is performed in a sequence of the data arranged in the vertical direction and the read-out from the memories l4a and l4b is performed in a direction perpendicular to the write-in direction, that is, in the horizontal direction.

According to the present invention, the color components are multiplexed by a carrier having a relatively low carrier frequency because the image pickup tube scans in a direction substantially parallel to the longitudinal direction of the stripes of the color stripe filter. For this reason, it is possible to obtain a high signal-to-noise ratio and to obtain a satisfactory color reproducibility. In addition, it is possible to have a wide frequency band for the luminance signal and to obtain a satisfactory horizontal resolution. Moreover, since the fundamental wave component and the second harmonic wave component are extracted by use of the filter circuit, it is possible to effectively reduce the generation of the pseudo color signal and accordingly reproduce correct colors.

Further, the present invention is not limited to these embodiments, but various variations and modifications may be made without departing from the scope of the present invention.

Claims

l. A color image pickup device comprising an image pickup tube (ll) and a color stripe filter (lla) comprising a plurality of stripe groups, each stripe group comprising a plurality of stripes, characterized in that said color stripe filter (lla) is arranged on said image pickup tube (ll) so that a longitudinal direction of the stripes of said color stripe filter is substantially parallel to a scanning direction of said image pickup tube; and that there is provided: a filter circuit (40) for extracting a fundamental wave component and a second harmonic wave component from an output of the color stripe filter, and color multiplexed signal obtaining means (l3, l4a; l4b, l5, l6) for obtaining a color multiplexed signal by multiplexing color components obtained via said color stripe filter and said filter circuit in a direction perpendicular to said scanning direction for every one stripe group.

2. A color image pickup device as claimed in claim l, characterized in that said filter circuit comprises a first bandpass filter (40a, 40al) for extracting the fundamental wave component from the output of said color stripe filter, a second bandpass filter (40b, 40bl) for extracting the second harmonic wave component from the output of said color stripe filter, and an adder (45) for adding the outputs of said first and second bandpass filters.

3. A color image pickup device as claimed in claim 2, characterized in that said first bandpass filter (40a) comprises a first delay circuit (4l) for delaying the output of said color stripe filter by a first delay time and a first subtracting circuit (43) for subtracting the output of said color stripe filter from an output of said first delay circuit, and said second bandpass filter (40b) comprises a second delay circuit (42) for delaying the output of said color stripe filter by a second delay time and a second subtracting circuit (44) for subtracting the output of said color stripe filter from an output of said second delay circuit, outputs of said first and second subtracting circuits being supplied to said adder as the outputs of said first and second bandpass filters, said first and second delay times being set so that said first and second subtracting circuits perform subtraction between signals having a phase difference of approximately l80°.

4. A color image pickup device as claimed in claim 3, characterized in that each stripe group of said color stripe filter comprises a green stripe, a cyan stripe and a transparent stripe, said image pickup tube having approximately four scanning lines per one stripe group, said first delay time being set to two scanning line, said second delay time being set to one scanning line.

5. A color image pickup device as claimed in claim 2, characterized in that said first and second bandpass filters (40al, 40bl) are constituted by feedback type filters.

6. A color image pickup device as claimed in claim 5, characterized in that said first bandpass filter (40al) comprises a first coefficient multiplier (50) supplied with the output of said color stripe filter, a first adding circuit (5l) supplied with an

output of said first coefficient multiplier, a first delay circuit (41) supplied with an output of said first adding circuit, a first subtracting circuit (43) for subtracting the output of said first adding circuit from an output of said first delay circuit and a second coefficient multiplier (52) supplied with an output of said first subtracting circuit and for supplying an output thereof to said first adding circuit, said second bandpass filter (40bl) comprises a third coefficient multiplier (53) supplied with the output of said color stripe filter, a second adding circuit (54) supplied with an output of said third coefficient multiplier, a second delay circuit (42) supplied with an output of said second adding circuit, a second subtracting circuit (44) for subtracting the output of said second adding circuit from an output of said second delay circuit and a fourth coefficient multiplier (55) supplied with an output of said second subtracting circuit and for supplying an output thereof to said second adding circuit, the outputs of said first and second subtracting circuits being supplied to said adder (45) as the outputs of said first and second bandpass filters, first and second delay times of said first and second delay circuits being set so that said first and second subtracting circuits perform subtraction between signals having a phase difference of approximately 180°.

7. A color image pickup device as claimed in claim 6, characterized in that each stripe group of said color stripe filter comprises a green stripe, a cyan stripe and a transparent stripe, said image pickup tube having approximately four scanning lines per one stripe group, said first delay time being set to two scanning line, said second delay time being set to one scanning line.

8. A color image pickup device as claimed in claim 1, characterized in that each stripe group of said color stripe filter comprises a green stripe, a cyan stripe and a transparent stripe.

9. A color image pickup device as claimed in claim 8, characterized in that said image pickup tube has approximately four scanning lines per one stripe group.

10. A color image pickup device as claimed in claim 1, characterized in that said color multiplexed signal obtaining means comprises an analog-to-digital converter (13) for subjecting the output of said image pickup tube obtained via said filter circuit to an analog-to-digital conversion, memory means (14a, 14b) for writing therein an output signal of said analog-to-digital converter in a sequence of data arranged in said scanning direction for every one stripe group and for reading out therefrom the stored signal in a sequence of data arranged in a direction perpendicular to said scanning direction for every one stripe group, and a digital-to-analog converter (16) for subjecting an output of said memory means to a digital-to-analog conversion so as to produce the color multiplexed signal.

11. A color image pickup device as claimed in claim 1, characterized in that there is further provided color demodulating means (17) for producing a color demodulated signal by subjecting said color multiplexed signal to a color demodulation.

12. A color image pickup device as claimed in claim 11, characterized in that said color demodulating means comprises a color demodulating circuit employing a step energy system.

FIG. 1

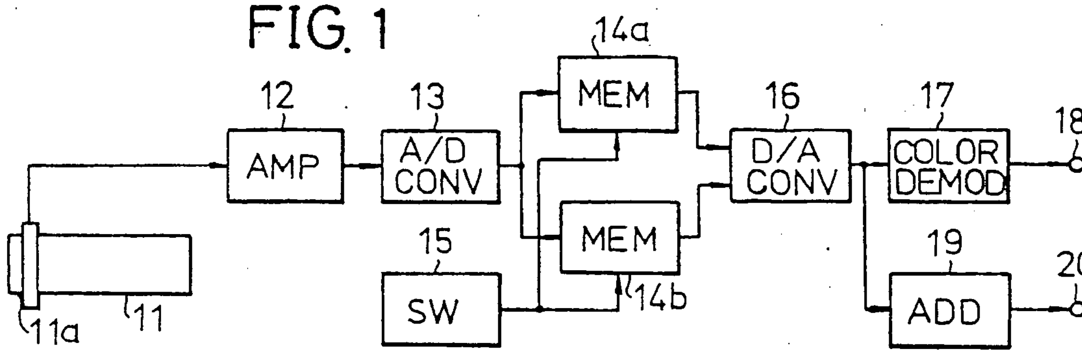


FIG. 2

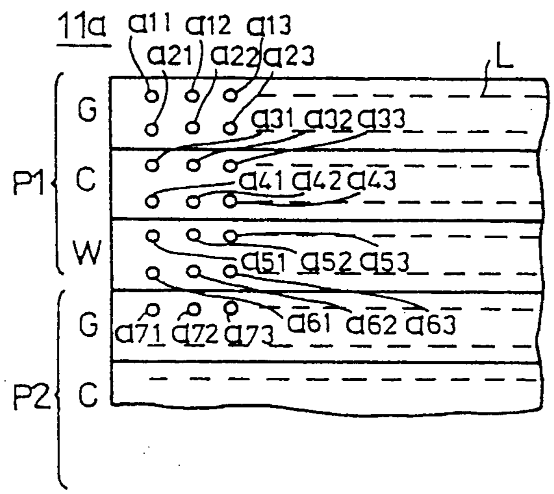


FIG. 3A

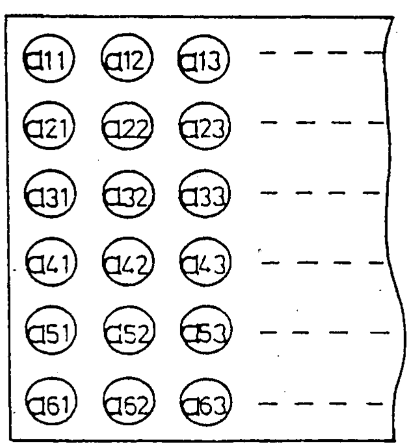


FIG. 3B

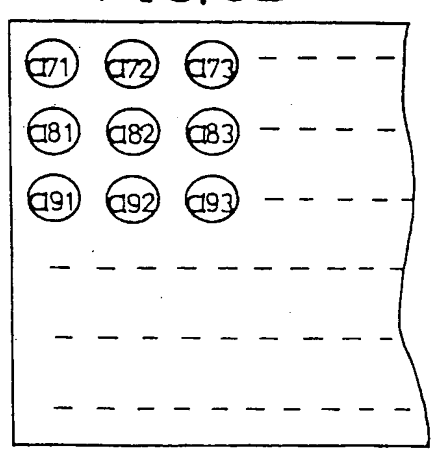


FIG. 4A

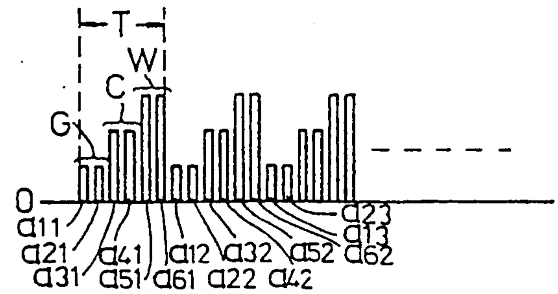


FIG. 4B

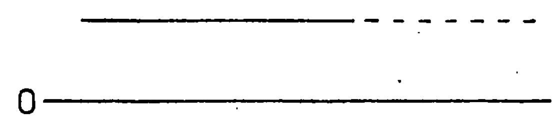


FIG. 7

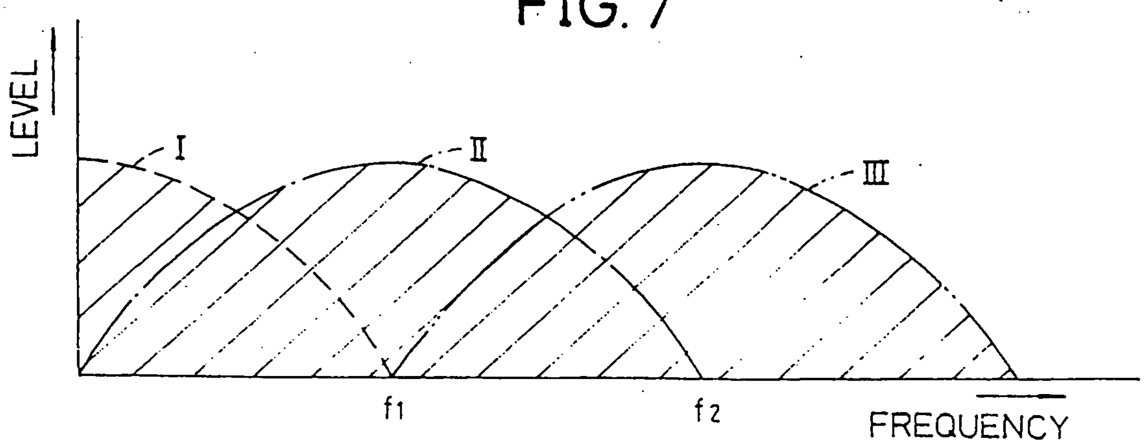


FIG. 5

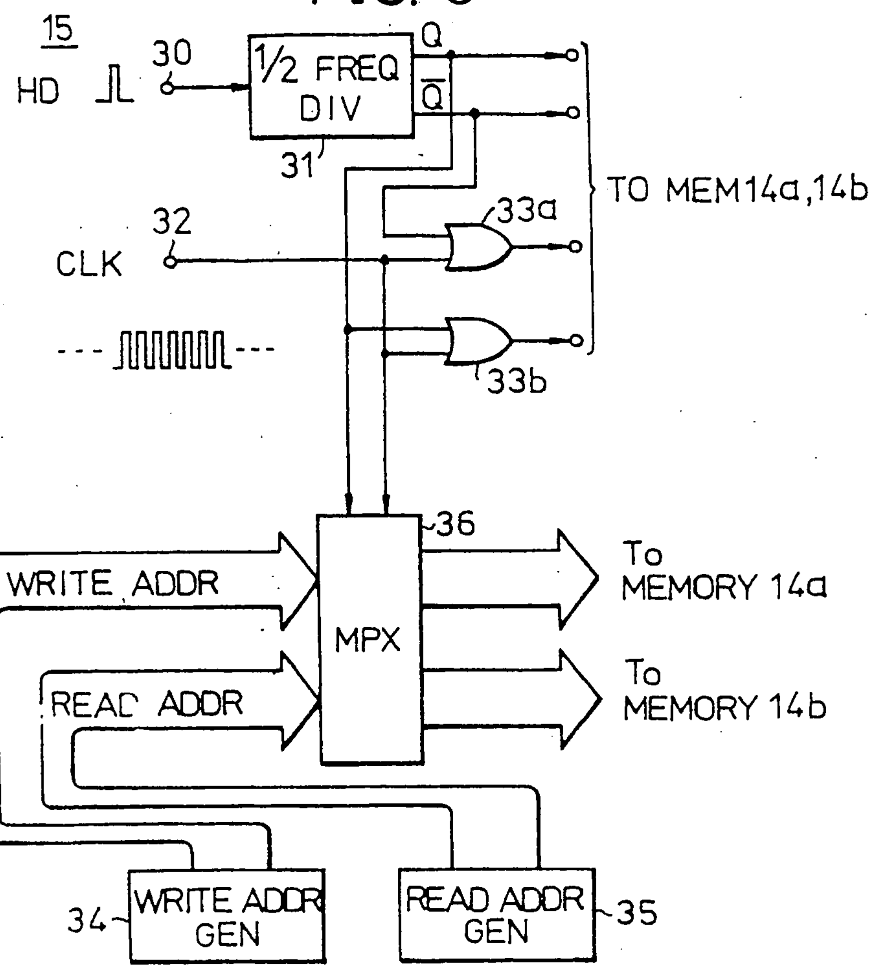

15
HD
30
1/2 FREQ DIV
31
Q
$\overline{Q}$
TO MEM14a,14b
32
CLK
33a
33b
36
MPX
WRITE ADDR
READ ADDR
To MEMORY 14a
To MEMORY 14b
34
WRITE ADDR GEN
READ ADDR GEN
35

FIG. 6

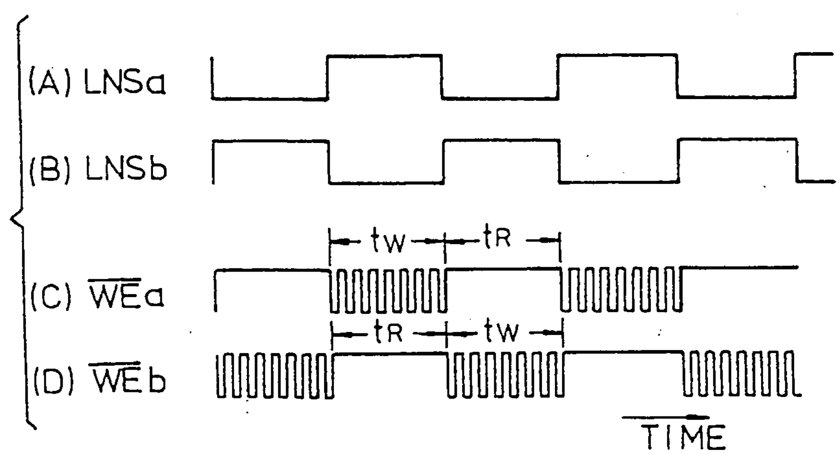

(A) LNSa
(B) LNSb
(C) $\overline{WE}$a
(D) $\overline{WE}$b
tW
tR
TIME

FIG. 8

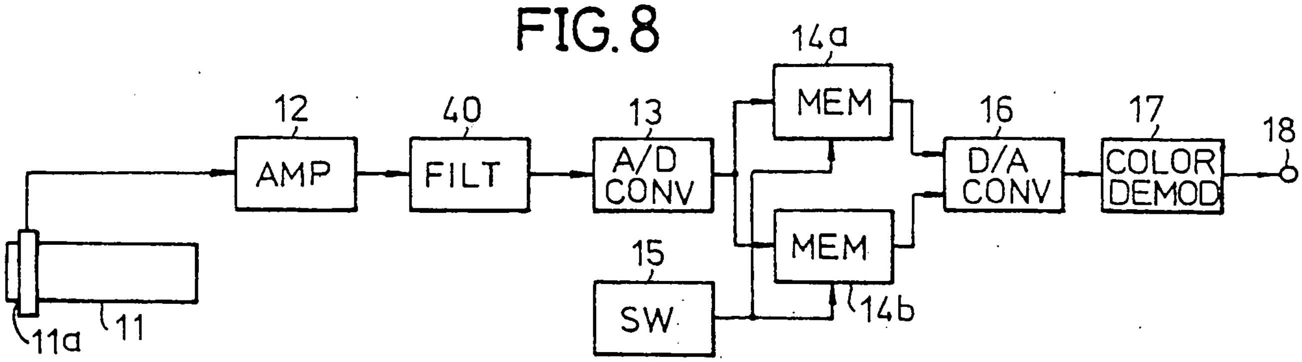


FIG. 9A

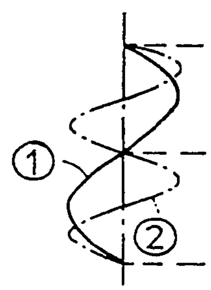


FIG. 9B

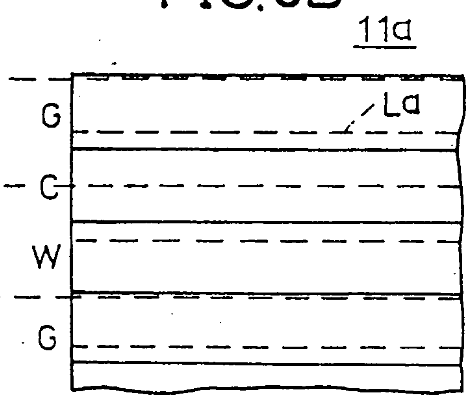


FIG. 10

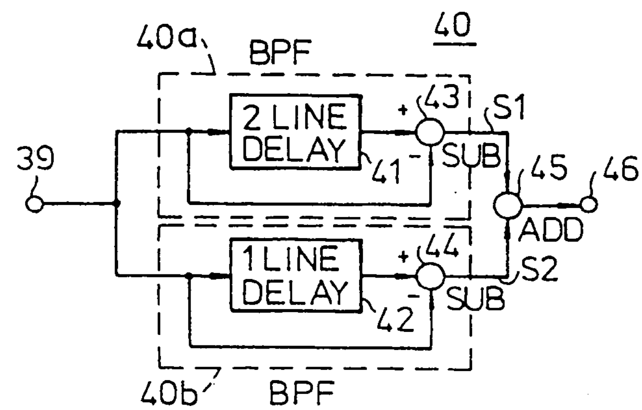


FIG.11

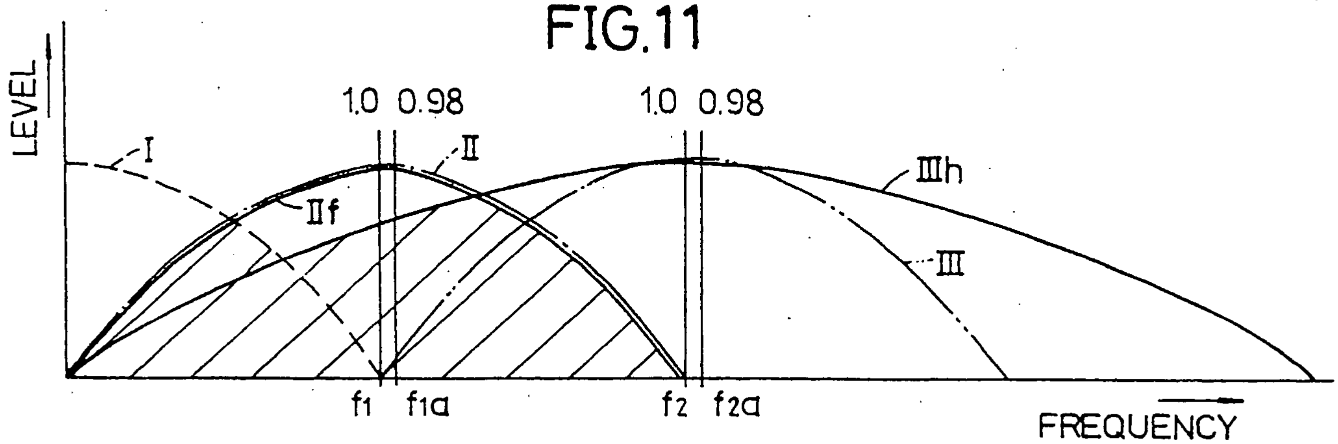


FIG.12A

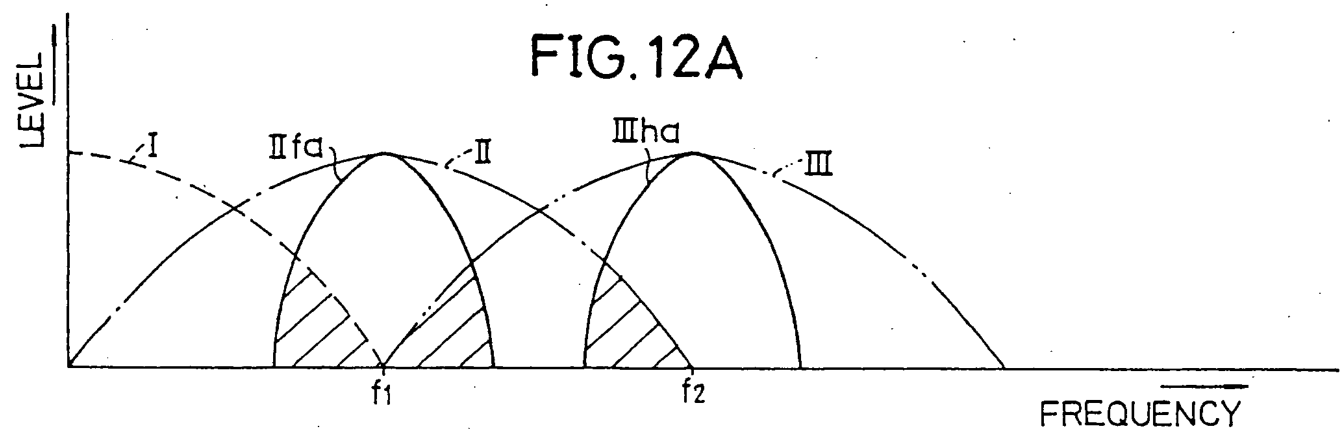


FIG.12B

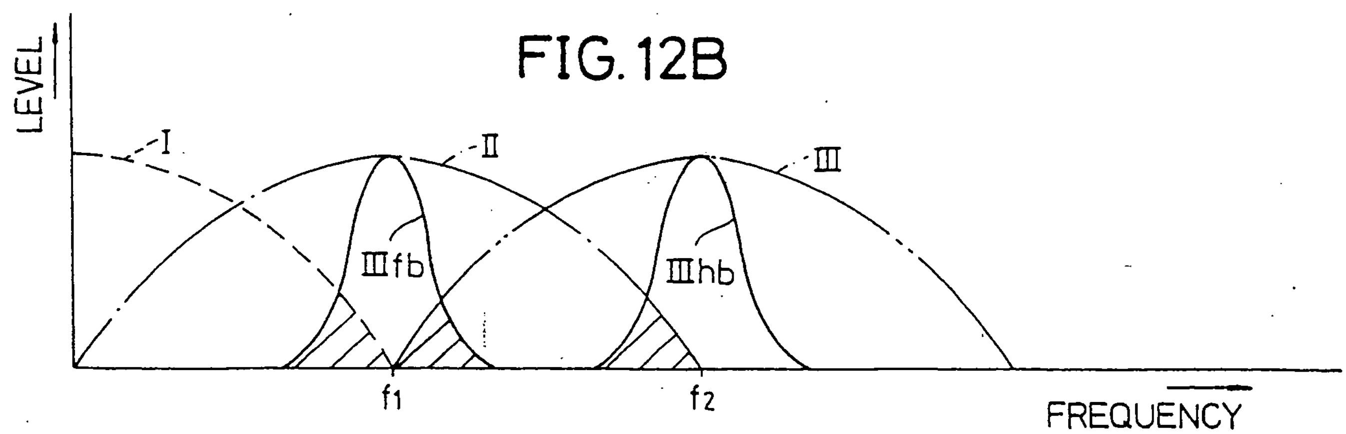
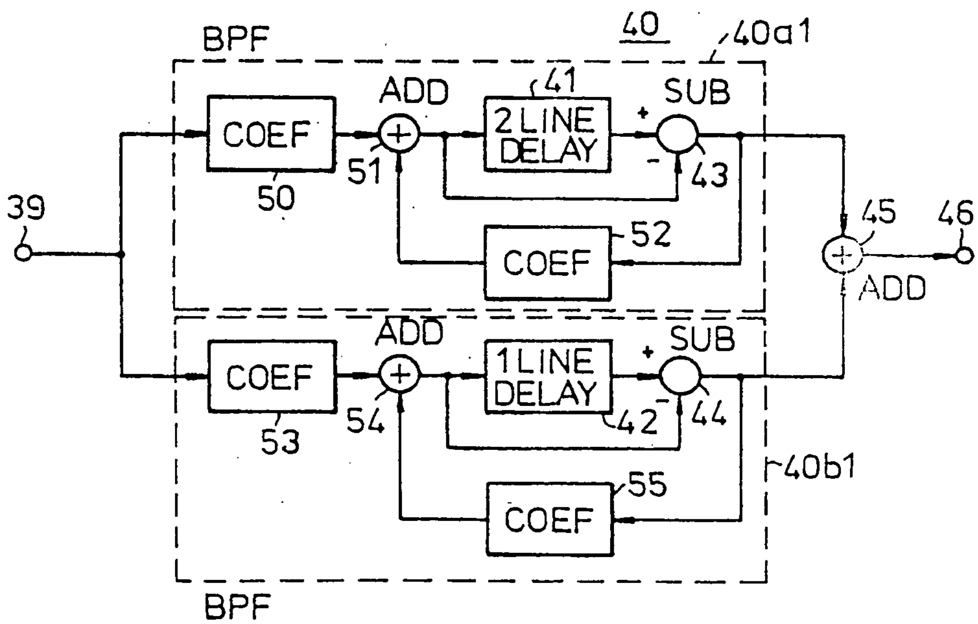


FIG.13



40
40a1
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41
SUB
COEF
2 LINE DELAY
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51
43
50
39
45
46
52
COEF
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ADD
SUB
COEF
1 LINE DELAY
+
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54
42
44
53
40b1
55
COEF
BPF

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(54) Color image pickup device.

(57) A color image pickup device comprises an image pickup tube II, a color stripe filter IIa comprising a plurality of stripe groups each having a plurality of stripes, a filter circuit 40 for extracting a fundamental wave component and a second harmonic wave component from an output of the color stripe filter, and a circuit I3, I4a, I4b, I5, I6 for obtaining a color multiplexed signal by multiplexing color components obtained via the color stripe filter and the filter circuit in a direction perpendicular to the scanning direction for every one stripe group. The color stripe filter is arranged on the image pickup tube so that a longitudinal direction of the stripes of the color stripe filter is substantially parallel to a scanning direction of the

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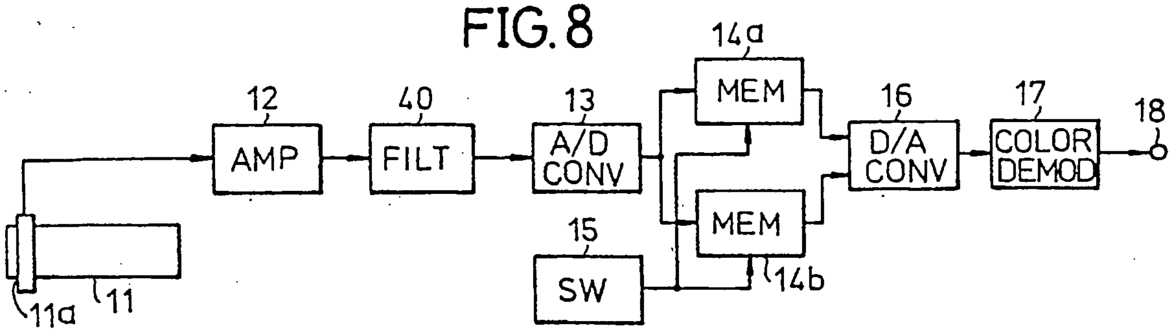
image pickup tube. A color demodulated signal is produced from the color multiplexed signal.

FIG. 8



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EUROPEAN SEARCH REPORT

Application Number

EP 86 31 0089

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	PATENT ABSTRACTS OF JAPAN, vol. 5, no. 23 (E-45)[695], 12th February 1981; & JP-A-55 150 686 (HITACHI SEISAKUSHO K.K.) 22-11-1980 * Abstract * ---	1	H 04 N 9/07 H 04 N 9/077
Y	US-A-3 651 250 (DISCHERT) * Figure 2; column 2, lines 39-67 *	1	
A	---	2	
Y	US-A-3 591 706 (PARKER-SMITH et al.) * Column 2, line 38 - column 3, line 13 * ---	1	
A	US-A-3 969 763 (TAN) * Figure 1; column 2, line 58 - column 3, line 37; column 4, line 48 - column 5, line 34; column 5, line 65 - column 6, line 46 * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 04 N 9

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-01-1989	DUHR R.H.J.E.

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